DATA TRANSMISSION DEVICE

FIELD OF THE INVENTION

The present invention relates to a data transmission device on a common medium having a central station and a plurality of subscribers, which is controllable by transmitting data

5   packets from the central station to the subscribers (downlink) and from the subscribers to the central station (uplink).

BACKGROUND INFORMATION

German Patent Application No. 197 26 120 describes a device

10   where the central station assumes the coordinating function for media access via a protocol-oriented transmission frame referred to there as signaling periods. This transmission frame contains, in addition to the useful signal data phases, signaling data phases for the uplink and the downlink.

The method described in German Patent Application No. 197 26 120 includes the step that the position of the downlink signaling is announced in the previous downlink signaling. This method presents the problem that a subscriber (terminal)

20   that wishes to log into the communication process has no previous information regarding the position of the downlink signaling (Broadcast Channel, BCH). Therefore, this terminal must demodulate the transmission channel until it has found a BCH and has demodulated the information about the position of

25   the next BCH. Access to the transmission channel can therefore only take place in the following transmission frame.

SUMMARY

In accordance with an example embodiment of the present

30   invention, faster access to the transmission channel is made possible. By dividing the downlink signaling data phase into

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SUBSTITUTE SPECIFICATION

signaling data phases related to the central station and related to the protocol, these two signaling data phases can be flexibly positioned at different points of the transmission frame. This allows the available transmission capacity to be fully utilized, in particular in the case where the DL-PDUs (Downlink Protocol Data Units) are composed of elements having different lengths. If the position of the BCH were constant, it might not be possible to fill the entire period between the start of the transmission frame and the protocol-related signaling data phase with useful data due to the flexible duration of the DL-PDUs. This would result in loss of transmission capacity.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a communication network having a central station and subscribers connected through a common medium.

Figure 2 shows the basic structure of a transmission frame according to an example embodiment of the present invention.

Figure 3 shows an example of a transmission frame according to the present invention.

Figure 4 shows a transmission frame having identifiers before the protocol-related and the central station-related signaling data phases.

Figure 5 shows a transmission frame having a direct identifier only before the protocol-related signaling data phase.

Figure 6 shows a transmission frame having an identifier immediately before the signaling data phase related to the central station.

DETAILED DESCRIPTION

Figure 1 shows a communication network for a communication

system. A central station 1 communicates via a common
transmission medium 11 having subscribers 21, 22, 23, etc. in
the form of terminals, central station 1 being responsible for
the coordinating function for media access (Medium Access
5   Control, MAC) to the jointly utilized medium. Central station
1 may be connected to a higher-level network, so that
terminals can connect to one another and to other subscribers
in the network. It is, however, also possible that the central
station 1 is not connected to a network, so that the terminals
10   can only communicate with central station 1 and with one
another. In this case, the traffic always goes through central
station 1 or the direct exchange between terminals must be
coordinated by central station 1. A jointly utilized
transmission medium 11 is a wireless channel, for example, but
15   can also be a PON (Passive Optical Network) or an HFC (Hybrid
Fiber Coax) network.

Figure 2 shows the structure of a transmission frame for the
communication network illustrated in Figure 1. Transmission
20   frames 3 are labeled here as MAC frames, contrary to German
Patent Application No. 197 26 120 or A. Krämling *et al.*
"Performance Evaluation of MAC Schemes for Wireless ATM
Systems with Centralised Control Considering Processing
Delays" EPMCC, Bonn, 1997, where they are labeled as signaling
25   periods. At the beginning of a transmission frame 3, downlink
signaling data phase 42 - BCH (Broadcast Channel) - appears.
It is followed by useful signal data phase 41 for the
downlink. It is labeled as DLCH (Downlink Channel) and
includes N useful data time slots for the DL-PDUs (Downlink
30   Protocol Data Units). Similarly, M useful data time slots are
provided for the UL-PDUs (Uplink Protocol Data Units) for
useful signal data phase 51 of the uplink ULCH (Uplink
Channel). Uplink signaling data phase 52 is labeled as RACH
(Random Access Channel).
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Download signaling data phase BCH is divided into two

categories as shown in Figure 2: a signaling data phase 421 related to the central station - BCCH (Broadcast Control Channel) - and a protocol-related signaling data phase 422 - FCCH (Frame Control Channel). In BCCH 421, central station 1

5   can forward information to the terminals that is of global relevance for central station 1 and the communication with the connected terminals. This includes information such as capabilities of the central station, manufacturer information, current operating modes, and address of the central station.

10   On the other hand, FCCH 422 determines the structure and the contents of the remaining transmission frame 3 (MAC frame). Thus, FCCH has primarily local, MAC frame-related importance. In Figure 2, which only shows the principle of the frame structure, BCCH and FCCH are shown directly following one

15   another without taking into consideration the frame structure according to the present invention which is explained below.

Initially we shall assume that the position of the BCCH which contains the global information is always located at the

20   beginning of MAC frame 3. In this case, it is advantageous if the position of FCCH 422 is announced in BCCH 421. Furthermore, it can be advantageous if a special identifier is transmitted immediately before the occurrence of FCCH 422 in addition to the identifier at the beginning of MAC frame 3

25   (see, German Patent Application No. 197 26 120 and Karsten Brüninghaus, Markus Radimirsch, "Coarse Frame Synchronisation for OFDM-Based Wireless Communication Systems," PIMRC, Boston, 1998). It is advantageous if this identifier is different from the identifier at the beginning of MAC frame 3; however, in

30   principle, it may also be identical to it.

An exemplary MAC frame 3 for a device according to the present invention is illustrated in Figure 3. MAC frame 3 begins with an identifier 6, which unambiguously indicates that this is

35   the beginning of the MAC frame. An example of such an identifier is described, for example, in German Patent

Application No. 197 26 120. It is followed by signaling data
phase 421 - BCCH - which contains, among other things, the
time interval (indirect identifier) between BCCH and FCCH -
T index (BCCH - FCCH). This information is evaluated by
5   terminals 21, 22, 23, etc., so that FCCH can be demodulated in
a controlled manner as needed.

For this purpose, reference points in time are established;
these are the end of the BCCH and the beginning of the FCCH in
10   the example according to Figure 3. The time reference of the
BCCH may also be located at the beginning or at a point in
time in the middle of the BCCH or it may be the identifier
itself. The reference point in time of the FCCH could also be
at the beginning or at some point in the middle of the FCCH. A
15   terminal may also receive this time interval T index (BCCH -
FCCH) as a fixed value from the manufacturer. This interval
can also be determined on the basis of manufacturer-specific
considerations or from a standard.

20   Another option is a flexible interval T index (BCCH - FCCH),
which is calculated by central station 1 as a function of the
requirements of each situation and communicated to the
terminals. The current interval can be transmitted to the
terminals in the BCCH. This allows the entire DLCH 41
25   (Downlink Useful Data Signal Phase 41) to be filled if the
length of the DL-PDUs is not constant, as explained
previously, but is composed of elements having different
durations.

30   The granularity of this time interval can be measured in
system cycles; in general, the system clock is specified in a
standard. Another option is the explicit specification of a
time granularity which may be the duration of the smallest
unit from which a DL-PDU can be composed, for example. This
35   time granularity is a common divisor of the durations of all
possible DL-PDUs. The function of the FCCH is described in

detail in German Patent Application No. 197 26 120 and A.
Krämling *et al.* "Performance Evaluation of MAC Schemes for
Wireless ATM Systems with Centralised Control Considering
Processing Delays" EPMCC, Bonn, 1997; it assigns time slots to
5   the terminals for reception and transmission. Both the
chronological sequence of the individual elements of a MAC
frame 3 and the effects of the FCCH are specified there. A
terminal that wishes to log onto the network can calculate the
position in time of the remaining elements of MAC frame 3 and,
10   of course, also of the RACH from the information of the FCCH
and, using this information, begin communicating with the
central station.

Additional possible embodiments of the present invention are
15   presented below:

BCCH 421 is not located directly at the beginning of MAC frame
3, but has a constant distance from the beginning of the MAC
frame.

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It is also possible to identify the position of FCCH 422
through an additional identifier. In this case, the following
combinations are possible:
- an additional identifier 62 is transmitted before FCCH 422;
25   this identifier can be advantageously distinguished in the
receiver from identifier 61 located before BCCH 421. It is
also possible that FCCH 422 is announced in BCCH 421 or that
BCCH 421 announces the position of FCCH 422. This is
illustrated in Figure 4.
30   - no identifier is inserted before BCCH 421, so the identifier
62 before FCCH 422 is unique and it unambiguously identifies
the position of FCCH 422. Also in this case, FCCH 422 may or
may not be announced in BCCH 421. This is illustrated in
Figure 5.
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If the position of BCCH 421 is not located at the beginning of

MAC frame 3, which is provided with identifier 6 as a frame identifier, it may be advantageous to transmit an easy-to-detect additional identifier 61 immediately before BCCH 421. This is illustrated in Figure 6. Here too, an additional

5   identifier may be inserted before FCCH 422; identifier 61 may be present before BCCH 421 or it may be omitted.

SUBSTITUTE SPECIFICATION

New Claims

What is claimed is:

1. A method for data transmission on a common medium comprising a central station (1) and a multiplicity of subscribers (21, 22, 23, etc.), data packets being transmitted from the central station (1) to the subscribers (21, 22, 23, etc.) (downlink) and from the subscribers (21, 22, 23, etc.) to the central station (1) (uplink), the central station (1) being responsible for the coordinating function for media access via a protocol-oriented transmission frame, and a transmission frame (3) having, in addition to useful signal data phases (41, 51), signaling data phases for the downlink (42) and the uplink (52), having the following measures:
- the signaling data phases for the downlink (42) are divided into signaling data phases (421) related to the central station and signaling data phases (422) related to the protocol;
- at least one identifier (6, 61, 62) of the position in time of the protocol-related signaling data phase (422) of the downlink is provided in the transmission frame (3);
- this identifier (6, 61, 62) of the position in time of the protocol-related signaling data phase (422) of the downlink is directly included in a signaling data phase for the downlink.

2. A method for data transmission on a common medium having a central station (1) and a multiplicity of subscribers (21, 22, 23, etc.), data packets being transmitted from the central station (1) to the subscribers (21, 22, 23, etc.) (downlink) and from the subscribers (21, 22, 23, etc.) to the central station (1) (uplink), the central station (1) being responsible for the coordinating function for media access via a protocol-oriented transmission frame, and a transmission frame (3) having, in addition to useful signal data phases (41, 51), signaling data phases for the downlink (42) and the uplink (52), having the following measures:

- the signaling data phases for the downlink (42) are divided
into signaling data phases (421) related to the central station
and signaling data phases (422) related to the protocol;
- at least one identifier (6, 61, 62) of the position in time
of the protocol-related signaling data phase (422) of the
downlink is provided in the transmission frame (3);
- this identifier (6, 61, 62) of the position in time of the
protocol-related signaling data phase (422) of the downlink is
derived from another identifier (6, 61, 62), which is provided
in particular for the position of the signaling data phase
(421) related to the central station.

3. The method according to Claim 1 or 2,
wherein an announcement of the position of the protocol-related
signaling data phase (422) is provided in the signaling data
phase (421) related to the central station for indirectly
identifying the protocol-related signaling data phase (422) in
that this announcement contains in particular the time interval
to the protocol-related signaling data phase (422).

4. The method according to one of Claims 1 through 3,
wherein the subscriber-related signaling data phase (421) is
provided at the beginning of a transmission frame (3).

5. The method according to one of Claims 1 through 4,
wherein an identifier (6, 61, 62) is provided immediately
before a signaling data phase (421) related to the central
station, which identifier is also used in particular for
identifying the beginning of a transmission frame (3).

6. The method according to one of Claims 1 through 3,
wherein the time interval between a signaling data phase (421,
422) related to the central station and one related to the
protocol is specified as a fixed value

7. The method according to one of Claims 1 through 3,
wherein the time interval between a signaling data phase (421,

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422) related to the central station and one related to the
protocol is variable and is communicated to the subscribers
(21, 22, 23, etc.) by the central station (1).

8. The method according to one of Claims 1 through 7,
wherein the time interval between a signaling data phase (421,
422) related to the central station and one related to the
protocol is filled with useful data.

9. The method according to one of Claims 1 through 3,
wherein a signaling data phase (421) related to the central
station is not provided immediately at the beginning of a
transmission frame (3), but has a constant distance in
particular from the beginning of a transmission frame.

10. The method according to one of Claims 1 through 9,
wherein the reference points in time are provided for the
signaling data phase (421, 422) related to the central station
and related to the protocol, these reference points in time
being located either at the beginning or in the middle of the
respective signaling data phase or in at least one identifier.

11. The method according to Claim 9 or 10,
wherein an identifier (61, 62) is provided before a signaling
data phase (421) related to the central station as well as
before a signaling data phase (422) related to the protocol,
these identifiers differing from one another in particular,
regardless of whether or not the position of the protocol-
related signaling data phase (242) is announced in the
signaling data phase (421) related to the central station.

12. The method according to one of Claims 1 through 10,
wherein an identifier (6, 61, 62) is only provided immediately
before the protocol-related signaling data phase (242)
regardless of whether the position of the protocol-related
signaling data phase (242) is announced in the signaling data
phase related to the central station.

13. The method according to one of Claims 1 through 12, wherein an additional identifier of the transmission frame (3) is provided independently of the identifiers (6, 61, 62) of the signaling data phases.

Abstract

In a device for data transmission having a central station (1)
and a plurality of subscribers (21, 22, 23, etc.), in addition
to useful signal data phases (41, 51), signaling data phases
are provided for the downlink (42) and uplink (52) in a
transmission frame (3).

The signaling data phases for the downlink (42) are divided
into signaling data phases (421, 422) related to the central
station and related to the protocol. The positions of these
two signaling data phases are identified directly or
indirectly by identifiers (6, 61, 62).

(Figure 4)